Public Report for ESA-205-2
FINAL

Company	Buzzi Unicem USA	**ESA Dates**	December 4 –6, 2007
Plant	Pryor, OK Plant	**ESA Type**	Compressed Air
Product	Cement	**ESA Specialist**	Tom Taranto

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

As an activity for the United States Department of Energy's Save Energy Now program, a Compressed Air System Energy Savings Assessment (ESA) was performed at Buzzi Unicem USA, Pryor, OK Plant. The assessment was supported by the site lead contact, David Puzan, Plant Manager and other team members listed above. The ESA was led by DOE compressed air qualified specialist, Tom Taranto, of Data Power Services, LLC.

Buzzi Unicem in Pryor OK is an integrated cement manufacturing plant operating three rotary kilns with annual capacity of 800,000 tons. The plant uses scrap tires as supplemental fuel input to the kiln. There are two raw mills and three finish mills. Finish Mill #3 was not operating during the assessment.

Objective of ESA:

Provide hands-on training for plant personnel to measure compressed air energy performance and investigate energy savings opportunities using DOE Best Practices and Software Tools. The compressed air system ESA includes an examination of both air supply and usage (demand) to establish present energy use and identify opportunities to improve efficiency and reduce energy use.

Focus of Assessment:

Compressed air for the Buzzi Unicem Pryor site is generated by a total of five compressors. Four are located in the mill area and supply mill air. The fifth compressor is located near the Pack House and is intended to service the Pack House and Shipping areas which require higher pressure than the mill air system. There is a manual crossover valve between the Pack House and Mill air systems. Total generation capacity of all compressors is 6,710 acfm at 1,213 kW total. Three compressors, 300 Hp each, operate on 4,160 Volt power and one 300 Hp compressor operates at 480 volt. The Pack House compressor is 200 Hp, operating at 480 volt. The focus of the assessment was to baseline the energy cost through data logging amperage for each operating air compressor. AIRMaster+ was used to profile each system to establish annual energy consumption and cost.

Demand side evaluation included walkthrough evaluation of various sectors of the air system. Plant personnel used their knowledge of plant operations and compressed air usage to locate potentially inappropriate uses which were reviewed. Major compressed air uses include a number of air lances ¾" to 1" diameter. These operate intermittently as needed and do not operate many hours during the year. A new dense phase transport system expected to require 180 scfm (average) is being installed but is not yet operational. Air slides are supplied by blowers, Fuji model 7A-27 is typical. However, compressed air is used in addition to and at times in place of the blower air supply. Dust collectors include 22 pulse jet style units that use significant amounts of compressed air.

Approach for ESA:

The general approach for this ESA included

- Review of the two compressor rooms including size and type of compressors
- Assess the distribution piping between mechanical rooms and the impact on compressor operation
- Review of compressed air support equipment (filters and dryers)
- Discussion of end-uses in the plant
- Discussion of plant operating schedule and compressor operating schedule
- Measurement of compressor operating characteristics
- Brief measurement of compressor and distribution system operations
- Data analysis with LogTool
- Energy analysis with AIRMaster+, including development of EEM's

Plant personnel were given hands-on measurement experience using transducers (current and pressure) and data loggers. The use of LogTool and AIRMaster+ was demonstrated. Plant personnel demonstrated operation of the Building Management System which provides operational supervision for the Clean Dry Air (CDA) system.

The site team determined that measurements would be made for 5 air compressors in the 2 separate compressor areas. To assess the systems pressure profile, a total of nine pressure measurement locations were selected. Pressure measurement locations selected were at each compressor, upstream and downstream of the Regenerative mill air dryer, and at the Pack House and Mill Air receivers. In order to collect the required 48 hours of data which LogTool requires to establish daytypes, measurement equipment was shipped to the site for installation prior to the on-site visit. The necessary transducers and data loggers with shipped to the site and all data collection equipment was installed and operating by Thursday November 29th. The site team was well prepared and very proactive in providing support for data collection and all ESA related activity during the time spent on-site.

Site Team Meeting

Upon arrival to the plant site on the morning of Tuesday December 4th, an introductory meeting was held to discuss the concepts of a compressed air assessment and to determine the schedule of work for the next few days. Team members' knowledge of plant operations and compressed air use provided guidance and a list of potential demand side opportunities to investigate.

Discussions of plant air system operation revealed that new compressors had been installed to allow older units to be available as back up generation capacity. While plant operation was unchanged, the "back up" compressor capacity is frequently required to run during normal operations. The site team determined that investigation of the balance between supply and demand along with evaluating compressor control response to system dynamics was a significant potential savings opportunity.

System Baseline and Key Findings

Present air system performance measurement of baseline operating data from Fri. 30 Nov. through Tue. 4 Dec. 2007 analyzed with AIRMaster+; calculates annual energy use of 7,504,659 kWh.

After the meeting, functional investigation of the site began. When checking the Pack House system, the operator advised that he had just shutdown operations because of low air pressure. He closed the crossover valve to the mill air system and resumed operation. As a consequence of the crossover valve being closed, mill air pressure dropped below 65 psig affecting production operations. A few minutes later the operators started the 300 Hp "back-up" compressor. The sequence of events actually started with valves sticking open on the Finish Mill #3 Dust Collector at 20:20 hrs Monday night. Then cool down purge air use of the regenerative air dryer at 10:20 am Tuesday caused the pressure decay affecting Pack House operations. As a result, power to the system increased by 195 kW (1,703,520 kWh per year) (8736 hrs). The actual energy use and cost would be in proportion to the actual number of hours per year the "back-up" compressor is operating.

Performance of the Buzzi Unicem compressed air system is determined by a number of interactive characteristics of the existing system design and operation.

The valve malfunction at Finish Mill #3 dust collector is a common failure particularly in the demanding cement mill environment. Presently when a failure occurs, all compressors are operated to maintain production. As long a production is not impeded, little priority is given to finding the source of excessive air consumption. Ultimately production interruptions do occur. To achieve savings dust collector air use must be controlled. Installation of "surge stations" for each dust collector will improve performance, and prevent failures from placing large air demand on the system which ultimately results in production interruption.

Compressor 001-5130 (TA2 amperage test point) is almost always operating at 60% of full load power. This could be a result of an incorrect control signal pressure, mal-adjustment, or mal-function of controls. As a result the compressor which should deliver almost 1,500 cfm is calculated to be delivering about 500 cfm.

- Compressor utilization is 80% with 5,300 cfm of running capacity to supply 4,300 cfm. If compressor 001-5130 could deliver full capacity there are times when another compressor could be shutdown.
- Installation of a sequencer control is calculated to save 801,493 kW per year. However, all compressor controls must be functioning correctly to gain the maximum benefit.

Artificial demand is estimated to be 600 cfm. Working pressure of 80 psig (primary receiver) is satisfactory for system operation and 75 psig is tolerable. System pressure is typically 90 psig or greater. Air use is virtually unregulated. Artificial Demand is estimated to be 60 cfm per psig. Operating 10 psig lower (at 80 psig) has the

potential to eliminate 600 cfm of artificial demand saving 654,697 kWh per year. Implementation cost is very low as there is presently a pressure / flow control installed. Commissioning can be done as soon as the new 8" mill air line is complete.

Compressor discharge pressure is presently operating at 100 to 105 psig and up to 115 psig for the Pack House compressor. Combining all compressors together requires a "spill valve" to allow excess air from the Pack House to enter the Mill air system while maintaining satisfactory pressure in the Pack House system. The present cross over valve is manually operated and cannot provide satisfactory performance. Using AIRMaster+ it is estimated that 5 psi reduction in compressor discharge pressure will save 313,286 kW per year.

Eliminating compressed air use at the slides is estimated to save 200 cfm which would be replaced by blowers consuming 10 kW.

Evaluating system opportunities through EEM's (Energy Efficiency Measures).

The stated objective of developing and presenting compressed air EEM's was accomplished by using compressor operating characteristic data measured during the ESA. Daytypes were identified using the LogTool software as input to AIRMaster+ to calculate baseline performance. Information related to the key findings above was input to AIRMaster+ to develop EEM's and estimate energy reduction and savings.

Projected energy reduction for all EEM's is 1,843,298 kWh (~25% reduction) at a cost savings of $93,547 per year. To realize the savings several aspects of system performance as described in "Key Findings" must all be addressed. Individual measures will not independently achieve the projected savings.

General Observations of Potential Opportunities:

- Total plant natural gas consumption for base period* **105,952 MMBtu**
- Total plant electrical consumption for base year period* **108,175,543 kWh**
- Total coal consumption **2,078,616 MMBtu**
- Total other solid fuel consumption **256,009 MMBtu**

*NOTE: base period is 12 months Sep 2006 to Aug 2007.

- Note: Identified potential energy savings are classified as Near Term, Medium Term, and Long Term opportunities. See definitions below:
  - Near term opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
  - Medium term opportunities would require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carryout further engineering and return on investment analysis.
  - Long term opportunities require testing of new technology and confirmation of performance technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.
- Estimate of the identified % plant electricity savings from
  a) Near Term opportunities 0.60%
  b) Medium Term opportunities 0.07%
  c) Long Term opportunities 1.03%
  d) Total of all opportunities 1.70%

Management Support and Comments: The assessment was conducted in a professional manner. ESA Specialist Mr. Taranto was very knowledgeable and his visit was beneficial in the assessment of the compressed air system of our facility. He offered insight into our current operation and offered suggestions for improvements. Worked very closely with plant personnel and spent many hours in the field obtaining useful data. I was impressed with Mr. Taranto's work ethic.

DOE Contact at Plant/Company: for follow-up regarding progress in implementing ESA results.
Mr. David Puzan, Plant Manager
Buzzi Unicem USA
2430 South 437
Pryor, OK 74362